surface features of these glaciers, the nature of the ice movement, the temperature of the ice at various depths and its relations to the air temperatures, the amount of surface melting, the possible transference of material from the surface portion to lower portions, the rates of movement, the advances and recessions of the glacial extremities, and the structure of the ice. There is an accessory discussion of the physiographic changes of the region in Pleistocene and earlier times.

The points that stand out most in the discussion are those which relate to the precipitation of snow and rain, the effects of climatic cycles on glacial movements, the stratification and granulation of the ice, its shearing planes, blue bands, and the possible methods of their development. A notable result is the demonstration by daily measurements of the shearing of layers of ice over one another, a phenomenon announced by Chamberlin as a result of his Greenland observations, but questioned by Russell and others. The conclusions relative to glacial movement lie essentially in the lines toward which the more critical recent studies by different investigators seem to be quite surely tending, a composite mode of motion embracing as factors of varying efficiency granular growth, granular intermovement, shearing of the sliding planes of the ice crystals, and shearing of the glacial layers over one another. An unsatisfactory flavor is given this by an effort, italicized as though important, to make plasticity mean something which plasticity does not usually mean, for no other apparent reason than to justify the retention of an old term which is likely to be either misleading or meaningless. The movement of the gliding planes of an ice crystal over one another is a plastic movement only in the forced sense that the sliding of cards in a pack, or of boards in a lumber pile, is a plastic movement, and such a movement is better called something else.

The work is very amply illustrated by excellent photographs and maps, and is an important contribution to glacial science.

T. C. C.

The Fauna of the Salem Limestone of Indiana. By E. R. CUMINGS, J. W. BEEDE, E. B. BRANSON, and ESSIE A. SMITH. Thirteenth Annual Report of the Department of Geology and Natural Resources of Indiana, 1906. Pp. 1187–1487, 47 plates.

The Salem limestone of Indiana is known generally to geologists and business men as the Bedford limestone, receiving its name from the town at which are located so many of the large quarries of this formation; but the name was preoccupied when given to this limestone, since Bedford had

already been used by Dr. Newberry for one of the important formations of Ohio. Several years ago the Indiana formation was renamed the Salem limestone by Dr. Cumings from another town in the Indiana district where the formation is also well shown.

The introduction to the report, written by Doctors Cumings and Beede, gives an interesting account of the occurrence of this fauna as well as of the localities at which it is most abundant. This formation occurs, stratigraphically, near the base of the Mississippian series of Indiana, resting in the northern part of its outcrop on the basal limestone of the Indiana Mississippian—known as the Harrodsburg—and, in a large portion of its southern outcrop, upon a shale. The formation is said to be rather lenticular in its occurrence, pinching out at two known localities, attaining a thickness of fifty or sixty feet in the vicinity of Bedford where it is typically developed, oölitic or semi-oölitic in structure, and frequently cross-bedded. In their typical development the fossils are characterized by their stunted form and extreme abundance. The authors state that "the cross-bedding of the rock, its water-worn fossils, the fact that they are stunted, and the oölitic or semi-oölitic character of the rock, wherever typically developed, preclude the idea of its pelagic origin and argue forcibly in favor of a semi-littoral or lagoonal origin, as is also indicated by its broadly lenticular occurrence. . . . .

"In general the gastropods and brachiopods found in the Salem limestone are forms indicative of shallow conditions, such forms as might inhabit coral reefs and lagoons where there is considerable agitation of the water." This part of the report is illustrated by five half-tones giving views of characteristic exposures of the limestone and a sixth plate showing a slab of the fossiliferous limestone from Bloomington.

The greater part of the report, however, is devoted to a systematic description of the fossils of this limestone which are here, for the first time, brought together, described, and illustrated in one work. As might naturally be expected, it contains a description of a considerable number of new varieties and species, and it is stated that, "The larger part of the time was spent in the study of the corals, bryozoans, etc., not represented in the works of Hall and Whitfield." The descriptions of the Protozoa, Pentremites, Echinoderma, Vermes, Brachiopoda, and Pelecypoda are by Dr. Beede. Miss Essie A. Smith contributes an interesting paper on the "Development and Variation of *Pentremites conoideus*," in the closing part of which she discusses the "dwarfing of the fauna of the Salem limestone." Miss Smith states that this limestone "was probably laid down in a lagoon or partially enclosed sea, and the dwarfing of the fauna was perhaps due in

part to the smallness of the body of water and to an overcrowding." It is also noted that the increased number of poral pieces connected with the hydrospires, which are regarded as the respiratory organs of Pentremites, "would indicate an effort of the animal to adapt itself to a depletion of oxygen in this ancient sea."

The descriptions of the Bryozoa and Gastropoda including Crustacea are by Dr. Cumings. The Bryozoa come from the top of the formation in an exceedingly soft, loose-grained, and greatly decomposed limestone, in which they are beautifully preserved. It is stated that, "Very few Bryozoa have ever been described from the famous oölitic limestones of Indiana," and that, "No better preserved fossils have ever been studied by the writer than these exquisite Fenestellids and other Bryozoa from the Dark Hollow quarries of Bedford." The descriptions of the Vertebrates, which consist of fish remains, were prepared by Professor Branson, of Oberlin College. This portion of the monograph is illustrated by forty-two plates which in their reproduction leave something to be desired, as is frequently the case in the illustrations of the fossils contained in the reports of state geological surveys similar to that of Indiana.

C. S. P.

Evidences of a Coblenzian Invasion in the Devonic of Eastern America. By JOHN M. CLARKE. *Festschrift zum siebzigsten Geburtstage von Adolf v. Koenen*, pp. 359–68.

Dr. Clarke has devoted a portion of each of several recent summers to the field examination and collection of fossils of the Devonian formations of eastern Canada. In connection with this investigation he has critically studied the Devonian faunas of Gaspé in eastern Quebec, Dalhousie in northern New Brunswick, and those of the eastern and central portions of Maine, and this paper contains a preliminary statement of the results which have been obtained. It will be remembered that the Lower Devonian of central Europe has generally been divided into two terranes, of which the Gedinnian is the older and the Coblenzian the younger.

It is stated that in Gaspé the Lower Devonian faunas are singularly profuse and are contained in a series of limestones reaching an approximate thickness of 1,500 feet. These limestones rest unconformably on Cambrian slates and have been divided into three terranes. The lowest one has been called the St. Alban beds by Dr. Clarke and its fauna "is an almost pure strain of the Helderbergian (especially Coeymans limestone and New Scotland beds) of New York." The middle division is the Cape Bon Ami beds with a sparse fauna which, however, has a similar relationship to that